Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences

Canadian Science Advisory Secretariat (CSAS)

Research Document 2014/009

National Capital Region

Harvesting seal products of high quality for human consumption

P-Y Daoust[1] and Zoé Stacey[2]

[1] Canadian Wildlife Health Cooperative, Atlantic Veterinary College, University of Prince Edward Island, Charlottetown, Prince Edward Island

[2] Canadian Food Inspection Agency, St. John's, Newfoundland and Labrador

May 2014

Canada

Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

Research documents are produced in the official language in which they are provided to the Secretariat.

Published by:

Fisheries and Oceans Canada
Canadian Science Advisory Secretariat
200 Kent Street
Ottawa ON K1A 0E6

http://www.dfo-mpo.gc.ca/csas-sccs/
csas-sccs@dfo-mpo.gc.ca

© Her Majesty the Queen in Right of Canada, 2014
ISSN 1919-5044

Correct citation for this publication:

Daoust, P.-Y. and Stacey, Z. 2014. Harvesting seal products of high quality for human consumption. DFO Can. Sci. Advis. Sec. Res. Doc. 2014/009. v + 34 p.

Aussi disponible en français :

Daoust, P.-Y. et Stacey, Z. 2014. Exploitation de produits du phoque de grande qualité destinés à la consommation humaine. Secr. can. de consult. sci. du MPO. Doc. de rech. 2014/009 v + 36 p.

TABLE OF CONTENTS

ABSTRACT IV

RÉSUMÉ V

PURPOSE 1

GENERAL PRINCIPLES OF CARCASS HANDLING 1

ASSESSING THE HEALTH OF SEALS – DISEASE RECOGNITION 3

EXTERNAL EXAMINATION 4

Body condition 5

Skin and haircoat 7

Eyes and nose 9

INTERNAL EXAMINATION 10

Blubber (fat) 11

Organ surfaces and internal surface of body wall 12

Joints 15

Lymph nodes 16

Lungs 21

Heart 24

Liver 27

Digestive tract (stomach, intestine) 28

Kidneys 28

ZOONOTIC DISEASES ASSOCIATED WITH SEALS 28

VIRUSES 29

Influenza 29

Calicivirus 29

Seal pox 29

BACTERIA 30

Brucellosis 30

Tuberculosis 30

Salmonellosis 30

Leptospirosis 31

Seal finger 31

PARASITES 31

Toxoplasmosis 31

Trichinellosis 32

ACKNOWLEDGMENTS 32

REFERENCES 32

GLOSSARY 34

ABSTRACT

The *Canadian Fish Inspection Act* and Regulations prohibit the export (including production of products for export) of fish (including marine mammals) that are tainted, decomposed or unwholesome. Seals that are unhealthy and that present a food safety risk to consumers are considered unwholesome. Therefore, any person involved in the harvest and further processing of seal products is required to apply preventative controls to help ensure that edible seal products meet Canadian food safety standards, and are acceptable for human consumption.

Inspection of seal carcasses at sea for the purpose of harvesting products for human consumption involves a number of unique challenges compared to that of domestic animals or terrestrial wildlife. These challenges make it particularly important for harvesters and processors to ensure that food safety preventative controls are consistently applied to all seal carcasses brought onboard vessels. There are limited opportunities to assess live seals in the field during harvest against food safety criteria. However, seal harvesters must try to do this to the best of their ability and avoid harvesting animals that are unacceptable for producing edible products. The Canadian Food Inspection Agency (CFIA) requested advice from Fisheries and Oceans Canada (DFO) to assist seal harvesters in visually assessing the health of live seals and carcasses at the time of harvest such that only seals suitable for the production of edible products are selected for further processing as human food. This Research Document is intended to provide technical information and training to the seal harvesting community for this purpose. Specifically, it addresses the criteria required to assess the health of seals as they are brought onboard sealing vessels and focuses on the initial steps of carcass handling and examination.

RÉSUMÉ

La *Loi sur l'inspection du poisson* et le règlement connexe interdisent l'exportation (y compris la fabrication de produits pour l'exportation) de poissons (et de mammifères marins) avariés, pourris ou malsains. Les phoques malades et qui présentent un risque relatif à la salubrité des aliments pour les consommateurs sont considérés comme malsains. Par conséquent, toute personne impliquée dans la chasse et le traitement des produits du phoque est tenue de prendre des mesures préventives pour aider à faire en sorte que les produits du phoque comestibles respectent les normes canadiennes de salubrité des aliments et qu'ils sont propres à la consommation humaine.

L'inspection des carcasses de phoques en mer afin d'en recueillir des produits destinés à la consommation humaine donne lieu à un certain nombre de défis uniques que l'on ne rencontre pas quand il s'agit d'animaux domestiques ou de la faune terrestre. Ces défis font qu'il est particulièrement important pour les chasseurs et les entreprises de transformation de s'assurer que des mesures de contrôle de la salubrité des aliments sont prises pour toutes les carcasses de phoques prises à bord des navires. Les occasions d'évaluer l'état sanitaire des phoques vivants sur le terrain pendant la chasse en fonction des critères de salubrité des aliments sont limitées. Toutefois, les chasseurs de phoques doivent faire de leur mieux pour ne pas capturer d'animaux inacceptables du point de vue de la fabrication de produits comestibles.

L'Agence canadienne d'inspection des aliments (ACIA) a demandé conseil à Pêches et Océans Canada (MPO) afin d'aider les chasseurs de phoques à procéder à une évaluation visuelle des phoques vivants et des carcasses au moment de la chasse afin que seuls les phoques qui conviennent à la préparation de produits comestibles soient sélectionnés pour une transformation ultérieure comme aliment destiné à la consommation humaine. Le présent document de recherche vise à fournir des renseignements techniques et une formation à cette fin aux communautés de chasseurs de phoques. Plus précisément, il traite des critères nécessaires à l'évaluation de la santé des phoques lorsqu'ils sont remontés à bord des navires phoquiers et est axé sur les étapes initiales de manipulation et d'examen des carcasses.

PURPOSE

This document is intended to provide information and training to the sealing industry, particularly sealers who are the primary harvesters, for the purpose of harvesting seal products of high quality for human consumption. It is written in a general manner, without reference to particular species of seals, as we intend it to be applicable to any species harvested in Canada.

We begin by outlining the general principles involved in assessing the health of seals and handling seal carcasses, from a behavioural assessment of the animal through to evisceration of the carcass ("General principles of carcass handling"). We then provide guidance for the external and internal evaluation of the animal to ensure that only healthy seals are harvested, using photos to show normal and abnormal features ("Assessing the health of seals – Disease recognition"). The section "Zoonotic diseases associated with seals" is less relevant to the evaluation of the health status of seals; it is intended to inform those handling seals and seal carcasses about some of the zoonoses (diseases that can be transmitted from animals to humans) that have been reported. Finally, the document includes a glossary of definitions for terms that may not be familiar to members of the industry.

GENERAL PRINCIPLES OF CARCASS HANDLING

Inspection of seal carcasses at sea for the purpose of harvesting products for human consumption involves a number of unique challenges as compared to that of domestic animals or even terrestrial wildlife.

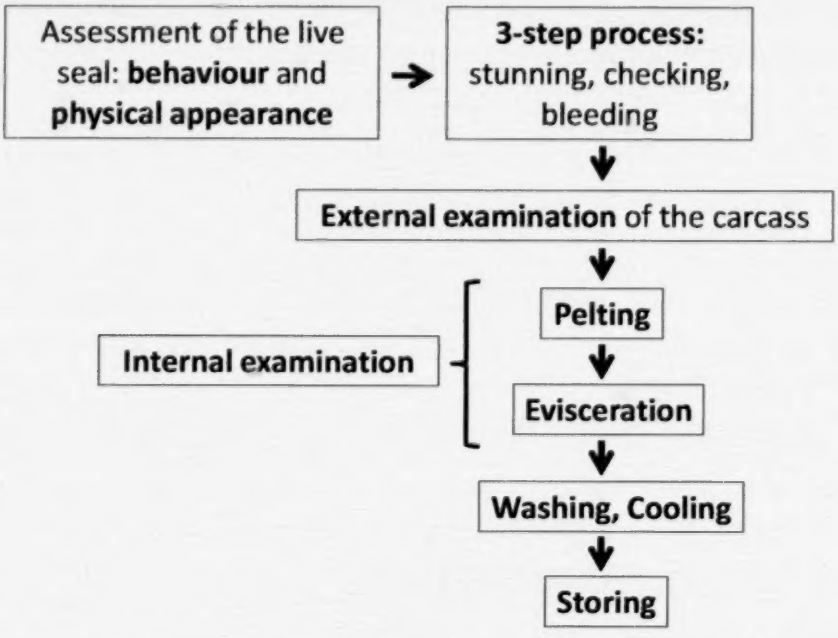

Figure 1. Diagram showing the series of critical steps that must be taken from the time that a seal is spotted to the time that its eviscerated carcass is stored in the hull.

These challenges make it particularly important for harvesters and processors to ensure that basic principles of health assessment and sanitation are consistently applied to all seal carcasses that are harvested. Harvesting practices must also respect basic principles of animal

welfare. To produce meat of high quality, the following procedures should be followed as outlined in Figure 1 and as they are described in the "Code of Practice for the Harvest, Transport, Processing, and Export of Seal Products Intended for Human Consumption", produced by the Canadian Food Inspection Agency (CFIA).

1. In normal slaughterhouse operations, domestic animals are given a visual inspection when still alive in order to detect any sign of weakness or disease such as coughing or diarrhea, so that they can be rejected before entering the slaughterhouse. This practice prevents potentially diseased carcasses from contaminating products from other animals.

By comparison, it is more difficult to assess the health of live seals in the field during harvest. However, the harvester (either the shooter through his rifle scope or the sealer prior to striking the seal with his hakapik or club) must try to do this to the best of his ability and avoid harvesting animals that show any evidence of weakness or disease. This begins with an assessment of the behaviour and overall physical appearance of the animal when alive (see section: External examination). Healthy seals will be alert and often exhibit threat behaviour or move away when approached. On occasion, harp seals may display a distinct 'freeze' behaviour with the neck contracted when disturbed. This is thought to be a fear-induced passive defense response in this species.

2. Bleeding must take place as soon as possible after the sealer has confirmed, by palpation through skin and blubber, that the seal's skull is crushed. This prevents pooling of blood in the muscles and accelerates cooling of the carcass, thus increasing meat quality. It is also a part of the 3-step process for killing seals (stunning, checking, bleeding) required by the *Marine Mammal Regulations* under the *Fisheries Act* of Canada to ensure that the animals are killed rapidly with minimal or no pain. These Regulations require that the carcass be left to bleed for 1 minute before being skinned.

During bleeding, contact of the exposed soft tissues (see Glossary) (blubber and muscle) of the carcass with dirty surfaces such as soiled ice or snow or the deck of the vessel must be avoided.

3. Prior to pelting, an external examination of the carcass must be performed if it could not be done properly on the live animal, to ensure that it does not show any external evidence of disease.
4. Seals must be pelted and eviscerated as soon as possible following completion of bleeding, and carcasses must be cooled quickly afterwards. No more than one hour can pass between bleeding and pelting/evisceration if the carcass is to be used for human consumption.
5. Pelting: In healthy seals, the fat layer (blubber) between skin and muscle is very thick, unless they are near the end of the annual moult. When seals are alive, the fat insulates the body and keeps the animal warm. Once the animal has been killed, the fat continues to insulate the body, keeping heat inside, which stimulates bacterial growth. If pelting is done immediately after completion of bleeding, it will allow faster cooling of the carcass. When the carcass cools quickly, any bacteria that might be present in the body, even after evisceration, are less likely to multiply. This will prevent the meat from spoiling.
6. Evisceration: To eviscerate the carcass, the entire digestive tract from the tongue to the anus must be removed, as well as the other internal organs (see Glossary). All animals have extremely large numbers of bacteria in their digestive tract (stomach and intestine). When an animal dies, the mechanisms which prevent the bacteria in the digestive tract from invading the rest of the body are shut down. If evisceration of an animal is delayed, these bacteria will likely contaminate the rest of the carcass. If evisceration is done

immediately after completion of bleeding, the meat is less likely to become contaminated. The meat will be of high quality and will maintain this quality for a longer period of time.

The Canadian Sealers Association provides a video, Seal Harvesting for Quality, which illustrates the proper method of evisceration of a seal carcass to ensure that products of high quality are harvested.

During evisceration, it is very important that the animal's digestive tract is not punctured or opened. Otherwise, the large number of bacteria normally present in the digestive tract will contaminate the carcass, rendering it unsuitable for human consumption. If this happens, contaminated parts of the carcass must be trimmed off and thrown away or the whole carcass must be discarded, and the knife must be disinfected.

If the seal is mistakenly shot through the abdomen, perforation of the digestive tract is likely and will cause extensive contamination of the carcass. The whole carcass should be discarded. If the bullet strikes the chest, contamination of the carcass is less likely, but parts of the muscle and rib cage damaged by the bullet must be trimmed off. If the heart has been damaged, it should be discarded.

7. During pelting and evisceration, an internal examination must be carried out, looking for evidence of abnormalities both outside and inside the pelted carcass and among the internal organs.
8. Carcasses must be handled carefully. Rough handling will tear muscle fibres, reducing meat quality.
9. After pelting and evisceration, the carcass and pelt must be washed separately with clean water. This is best accomplished by immersion in separate large vats filled with running cold seawater and dedicated to washing either the carcasses or the pelts. Washing the carcass will reduce bacterial contamination both on the outer surface and inside the body cavity. Cold, clean sea water is ideal for this as it also cools the carcass and pelt and slows down bacterial growth and fat oxidation.
10. If the flippers and organs such as the heart and liver are kept for human consumption, they must also be washed in cold, clean water. The flippers must be washed separately from the carcass and organs as the skin contains large numbers of bacteria. Before the liver is washed, the gall bladder (a small sac firmly attached to the liver and filled with dark green bile) must be removed carefully and discarded, making sure that it is not punctured in the process. If this happens and the liver surface is contaminated, it should be discarded as the strong bile pigments will cause discolouration. If bile spills on the carcass, the discoloured parts should be trimmed off and discarded.
11. Carcasses must be stored separately from pelts. The pelts' hair coat contains large numbers of bacteria and other microbes (see Glossary). Contamination of the meat will occur if the carcasses come in contact with the pelts.

ASSESSING THE HEALTH OF SEALS – DISEASE RECOGNITION

Most seals harvested during the hunt will likely be free of disease and will thus be suitable for human consumption. Nevertheless, in any given year, a small proportion of seals may show signs of disease, and every effort should be made to ensure that the carcasses of these animals are not included among those of healthy animals. This is why the carcasses of all seals harvested should be subject to a complete examination. This can be done without interfering with the efficacy of the harvesting process. If an animal has a disease, this can affect its whole body, including the meat. Some diseases known as zoonoses (see Glossary) can be

transmitted from seals to humans, especially if the meat is undercooked (see section: Zoonotic diseases associated with seals).

It is very important that diseased animals do not enter the human food chain. A seal should not be included in the harvest if the sealer is at all unsure about its health.

Infection is not the same as disease. Disease can be defined as a process resulting from a variety of causes (e.g., infection, starvation, hormonal malfunction) and which interferes with the function of the body or of parts of the body. By comparison, most animals carry (are infected by) a variety of microbes and parasites, e.g., in the mouth, nose, or any of the internal organs, without their function being affected. These microbes and parasites can potentially, but do not always, cause disease. In fact, infection in many cases is the normal state. It is usually when an animal is exposed to large numbers of microbes or parasites or weakened because of some other health problem such as starvation that these microbes or parasites are able to cause disease.

There are various degrees of disease. For example, a disease can be seen in only one organ of the body and may not necessarily affect the overall health of the animal. However, in order to ensure that seal products of the highest possible quality will be brought back to shore during seal harvest, the carcass and fat from seals which the sealer believes to show evidence of even minor disease should be discarded.

If a harvester notices signs of disease in a seal at pelting / evisceration, especially if similar signs keep showing up in different seals, he should notify the local area Conservation and Protection Fishery Officer from the Department of Fisheries and Oceans. This Officer will then inform regional science species experts and other relevant experts who will assess the significance of the harvester's observation and determine if it indicates an unusual disease.

The role of harvesters in identifying disease problems in seal populations and reporting them to the proper authorities is critical to the success of the industry because this will ensure that a proactive approach will be taken to monitor the health of the herd and thus prevent the inclusion of seals that are not acceptable as human food.

The purpose of this section is to provide information about the normal external and internal appearance of animal carcasses and about the different ways in which diseases can be recognized in seals. This information will allow harvesters to ensure that carcasses with any abnormality will be recognized.

Photos of some disease processes in domestic and wild land animals are used in this section because they are particularly good examples of these disease processes and because the basic anatomy and general disease patterns are the same in all warm-blooded animals. These similarities also reinforce the fact that seals are mammals and should be handled as such, whether they are alive or dead.

EXTERNAL EXAMINATION

Before a seal is harvested, the sealer must undertake an external examination to assess the condition of the animal. A healthy live seal will have clear eyes and a good body condition, and the fur will be in good condition (unless the seal is moulting) and have skin that is free of sores. However, this assessment may not always be possible prior to the animal's death, given that some seals will be shot at a distance. If this is the case, this examination must be done prior to pelting.

Body condition

Body condition in seals varies seasonally and by age. Young-of-the-year seals in good body condition are usually plump, with the mid-section of the animal wider than the shoulders (Figure 2). Adults during the breeding season will also be rather plump (Figure 3). Healthy seals during the moult will look thin (Figure 4) but will have clear eyes, a fur coat that is in good condition (although it may be losing hair), and skin that is free of sores.

Poor body condition is indicated by a thin blubber layer which causes the seal's shoulder blades, hips, and back bones to stick out and be easily recognized (Figure 5). Seals that are in poor body condition should not be harvested.

Figure 2. Young harp seal in good body condition. (Photo, G. Stenson)

Figure 3. Adult harp seal early in the whelping season and at maximum fatness. (Photo, G. Stenson)

Figure 4. Thin but otherwise normal harp seal near the end of its moult. (Photo, G. Stenson)

Figure 5. Emaciated (see Glossary) young grey seal. Its bones stick out because of its very thin blubber layer and muscle wasting.

Skin and haircoat

Hair loss in seals can be normal. It typically happens in an extensive way in the spring at moulting time, or it may occur in a few places simply from rubbing against surfaces. However, hair loss can also be associated with disease, in which case bald patches may be seen in various locations, or the entire body may be affected (Figure 6). Seals with extensive hair loss leading to large bald patches should not be harvested.

In addition to hair loss, seals with skin problems may have a crusty skin surface (Figure 7) and sores on the skin and/or around the mouth. These seals should not be harvested.

External parasites, such as lice, may be found on the skin. Parasites are common in all wild animals and usually do not cause disease. However, animals that have a large number of parasites visible on the skin may be unhealthy and should not be harvested (Figure 8).

Figure 6. Severe hair loss in a young hooded seal. This seal may have had some other underlying disease that would have made it unsuitable for harvest. (Photo, G. Stenson)

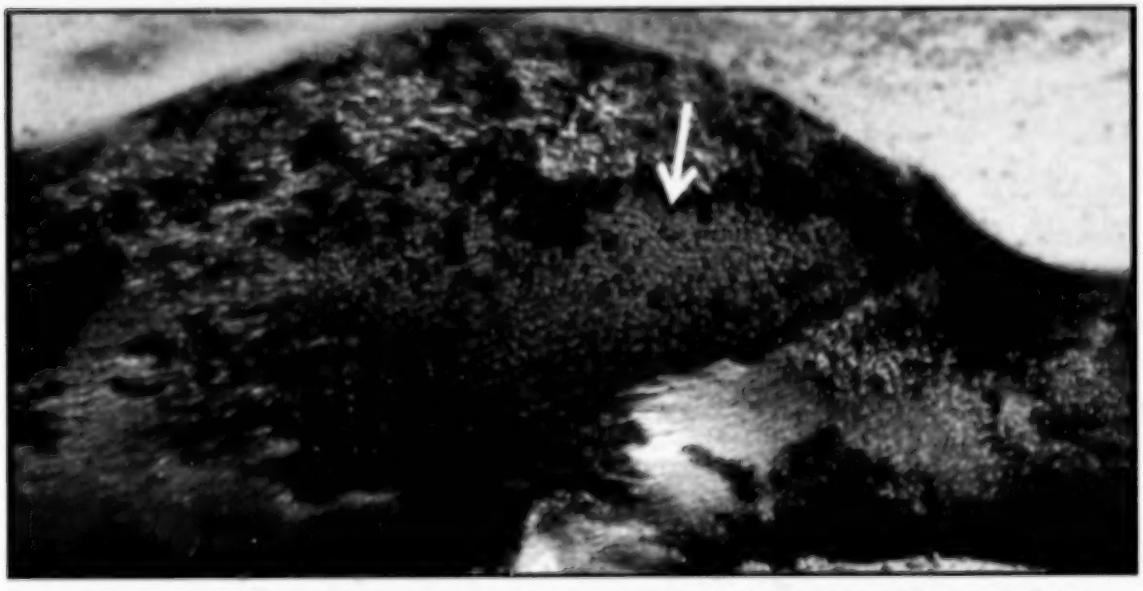

Figure 7. Unhealthy harp seal with patchy hair loss. The affected skin is also covered with a yellowish crust (arrow), which may have resulted from overgrowth of microbes (see Glossary). (Photo, Z. Lucas)

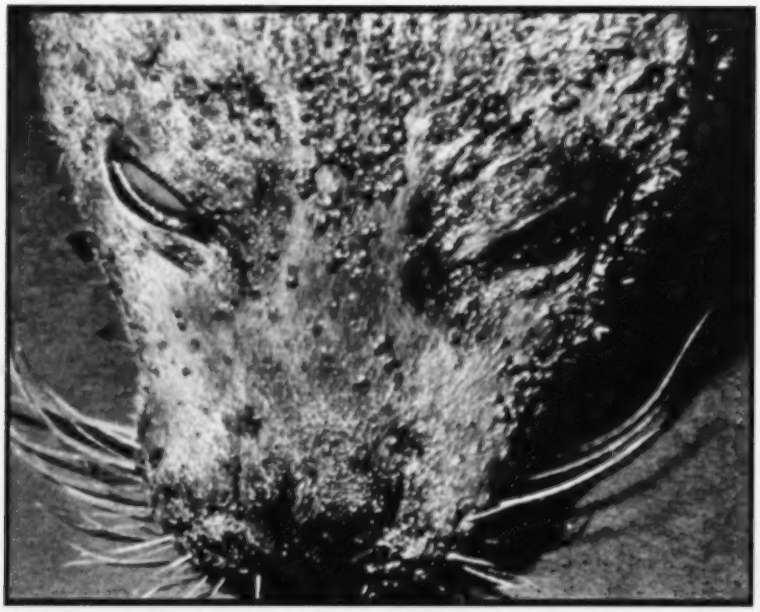

Figure 8. Lice covering the head of a harbour seal. Large numbers of external parasites on an animal may suggest that its body defences are weak and that it is unhealthy. (Photo, J. Geraci)

Eyes and nose

Sealers should watch for thick fluid coming from the eyes and nose, especially if it is yellow or green, which indicates a bacterial infection (Figure 9). However, small amounts of clear fluid discharge from the eyes or nose may simply be caused by irritation and are not of concern. A wet patch of fur around the eyes, a few centimetres wide, is also normal in seals since, in contrast to terrestrial mammals, they do not have ducts that drain tears from the eyes into the nose.

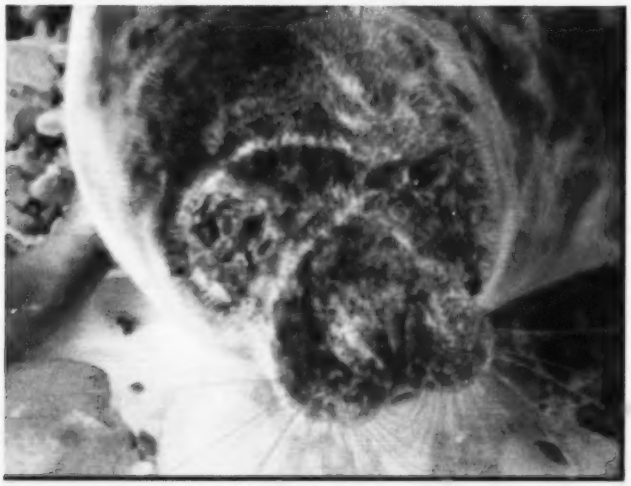

Figure 9. Unhealthy young grey seal with large amount of thick discharge from the eyes and nose probably caused by a bacterial infection. (Photo, C. Caraguel)

INTERNAL EXAMINATION

Although external examination may suggest that the seal is healthy, many diseases cannot be identified by external examination alone. Therefore, during pelting and evisceration, sealers should inspect the blubber, internal organs and joints (e.g., those of the hind flippers, which are usually cut off) for signs of disease. Experienced sealers who have opened hundreds of seal carcasses may have a very good idea of what a normal seal looks like. If a carcass is opened and the sealer notices something that stands out from his routine observations, he may not know the exact cause, but will recognize the abnormality and should discard this carcass. Figure 10 shows the normal internal appearance of a seal once it has been opened during pelting.

Parasitic worms are common in some organs of seals and other wild animals, such as the lungs, heart, liver and, especially, digestive tract, and are unlikely to affect the quality of the meat. However, animals that have large numbers of internal parasites are probably unhealthy and will likely have other abnormalities such as a thin blubber. The carcass and fat of these seals should be discarded.

Figure 10. Normal harp seal. Skin and blubber reflected, ribs removed, abdominal organs exposed. Lu, lung. H, heart. Li, liver. St, stomach. Int, intestinal tract. Only a very small portion of the spleen (S) is visible. (Photo, R. Russell)

Blubber (fat)

Because seals store most of their body fat as blubber under the skin, the thickness of this blubber is a good indication of the nutritional status and overall health of these animals. Blubber thickness varies at different times of year, and is deepest on the chest midway between the front flippers. In healthy seals, thickness will vary from 3 to 6 cm (Figure 11). A very thin blubber layer means that the seal is either starving or suffers from some chronic disease (see Glossary). The carcass of these seals should be discarded.

Normal blubber is white to cream coloured. In some cases, it may have an abnormal colour. In particular, yellow fat throughout the carcass may indicate jaundice caused by a serious disease such as chronic liver damage (Figure 12). The carcass and fat of these animals should be discarded.

Figure 11. Normal white colour and thickness of blubber, grey seal. (Photo, H. Fenton)

Figure 12. Yellow fat in the leg of a dog with liver disease (jaundice). (Photo., C. López-Mendez)

Organ surfaces and internal surface of body wall

The animal's internal organs and body wall should have a shiny surface (Figures 13 and 14). Organs should not stick to the body wall or to each other. Very firm attachments between organs or with the body wall are caused by scar tissue that has formed as a result of a chronic disease (Figure 15). The carcass and fat of these seals should be discarded.

If the surface of an organ looks dull or is covered by a layer of whitish or yellowish material, even if this layer is very thin, the animal is diseased, probably from an infection, and the carcass and fat should be discarded (Figures 16 and 17).

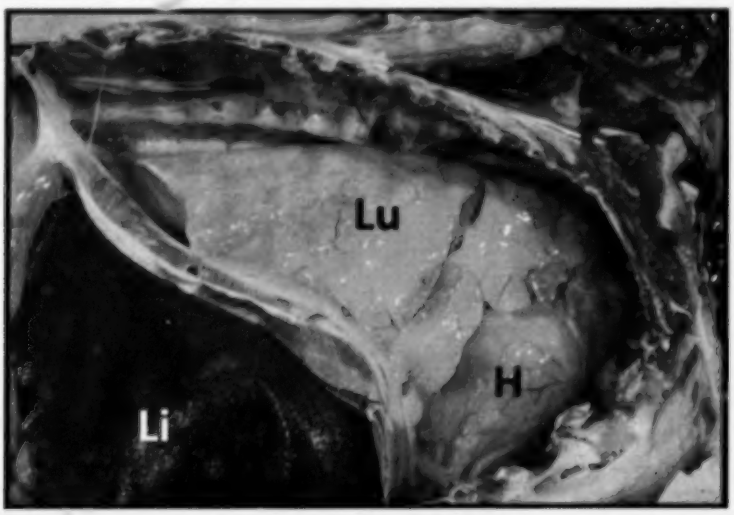

Figure 13. Normal shiny surface and normal colour of lung (Lu) and liver (Li) of a dog. The heart muscle (H) is hidden by the sac that normally surrounds it. (Photo, A. López)

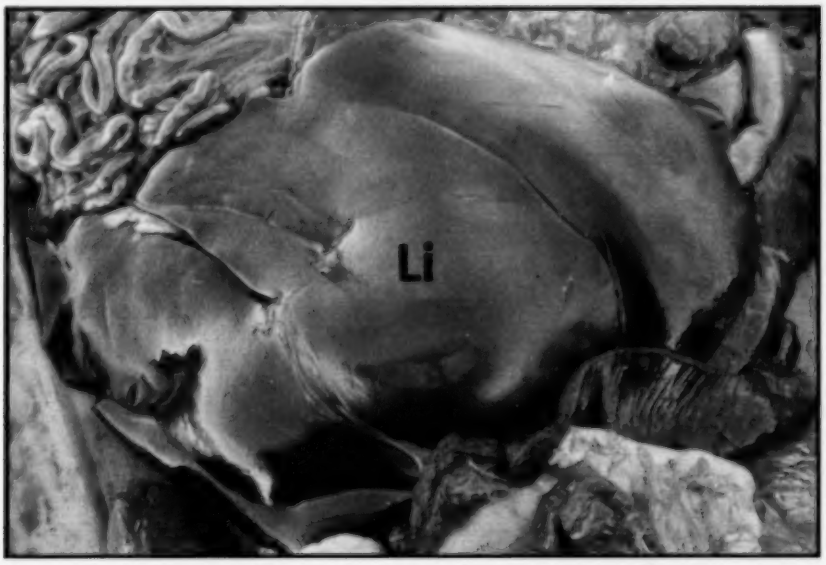

Figure 14. Normal shiny surface and colour of liver (Li) of a young grey seal. (Photo, H. Fenton)

Figure 15. Right lung of a cow with chronic (see Glossary) pneumonia (P), viewed from behind. The back part of the lung looks normal (N), but its front part is much darker than normal and would also feel much firmer than normal. In addition, because the pneumonia was chronic, there was time for scar tissue to form and solidly attach the diseased portion of the lung to the inner surface of the rib cage and to other parts of the lung (arrows). The mass indicated by the arrowhead is an enlarged lymph node. (Photo, A. López)

Figure 16. Body cavities (thorax [left] and abdomen [right]) of a cat suffering from a severe viral infection. A thin whitish film of inflammatory material (see Glossary) (arrow) covers a large portion of the liver, and the abdominal cavity contains a large amount of yellow gelatinous fluid (F).

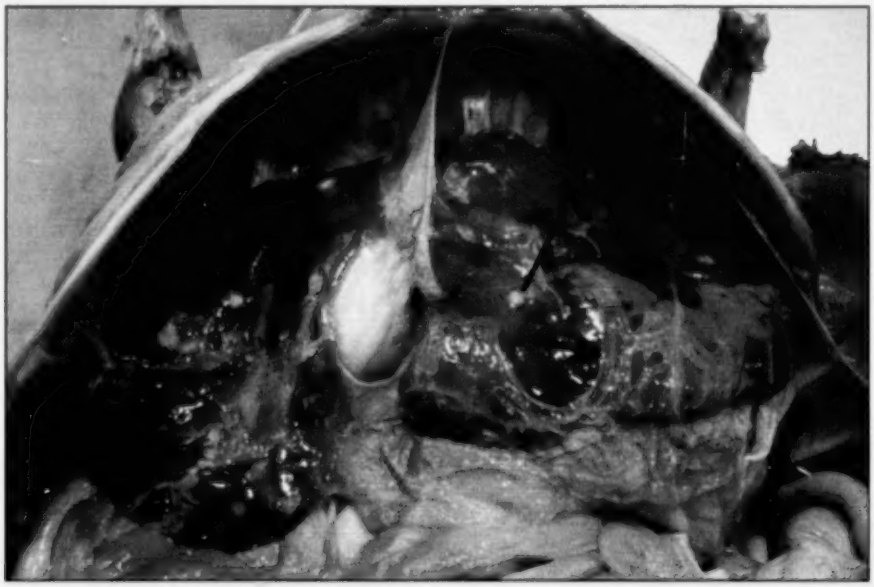

Figure 17. Abdominal cavity of a beaver with a chronic infection. Membranes from the abdominal cavity have become adherent to the surface of the liver (arrow). This organ also contains several white nodules (N) that correspond to old abscesses (see Glossary).

Joints

Normal joints contain a small amount of clear yellow syrupy fluid that lubricates the joint surfaces. A diseased joint will be swollen and filled with, or surrounded by, variable amounts of thick, cloudy, white or yellow fluid, or firm but crumbly material (Figure 18).

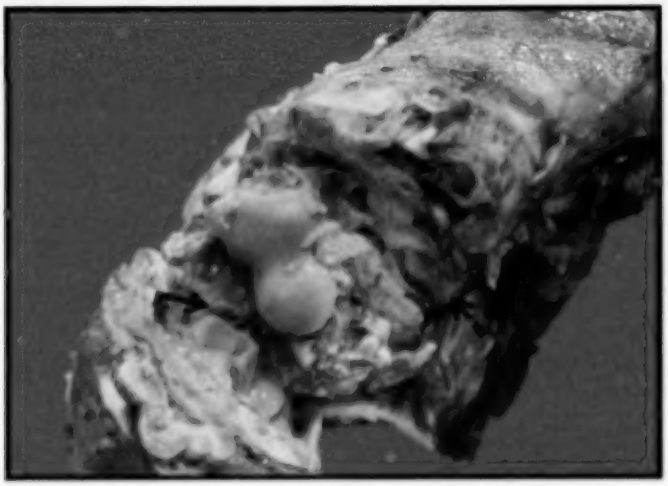

Figure 18. Severe chronic arthritis (joint inflammation) in the left leg of a cow, caused by a bacterial infection. The joint is surrounded by a thick layer of yellowish inflammatory material (arrows). (Photo, A. Bourque)

Lymph nodes

Lymph nodes are part of the body's immune system (see Glossary), which is responsible for fighting infections. A lymph node is a small round mass of white, grey, or occasionally red tissue which may have a uniform color or a mottled pattern when sectioned. It filters fluid that has leaked from small blood vessels and is being returned to the general blood circulation via a complex network of vessels called lymphatics.

When there is an infection in an area of the body drained by a lymph node, this node gets bigger (enlarges) as it reacts against microbes within the fluid that it filters, especially when the infection has been present for some time (roughly one week or longer) (Figure 19). **Lymph nodes that are enlarged are good indicators of disease.**

Lymph nodes are found throughout the body, more or less in the same locations in all species of mammals. The tonsils are an example of lymph nodes. The easier nodes to find for quick diagnosis of disease are under the jaw (although these can be confused with salivary glands, which are also in this location) and close to the lungs, liver, digestive tract, and kidneys (Figures 20-25).

In normal healthy seals, lymph nodes can vary considerably in size depending on their location. Most are small and not readily visible, but those associated with the intestine are normally quite large, typically forming a long, thick mass of tissue (Figure 24).

If, during pelting, the sealer notices large lumps near the jaw, lungs, liver and kidneys, this suggests that lymph nodes are enlarged throughout the carcass and that the animal suffers from a generalized disease. The carcass and fat of this animal should be discarded.

The adrenal gland is a very important structure which produces hormones. It is located just above each of the two kidneys and can be confused with a lymph node. However, it is flatter, and on cut surface it has a distinct outer zone and center (Figures 26 and 27).

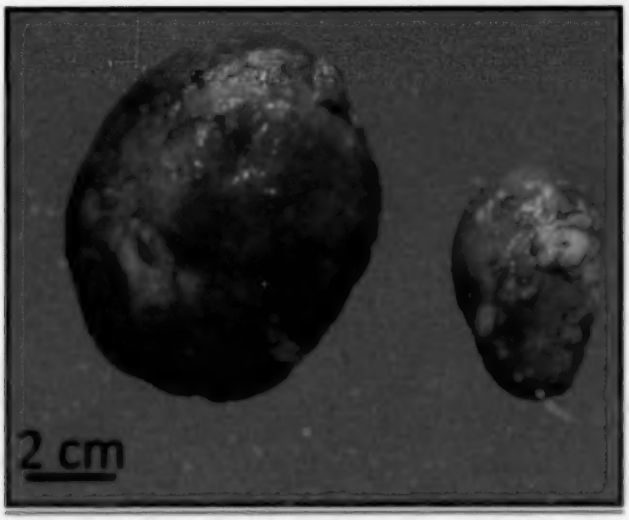

Figure 19. The lymph node on the left is from the left leg of a cow with a severely infected joint (see Figure 18). It is much larger than the lymph node taken from a similar location in the cow's right leg because it has reacted to bacteria coming from the infected joint.

Figure 20. Normal lymph nodes (arrows) under the jaw in a young grey seal. The salivary gland (SG) is larger. (Photo, H. Fenton)

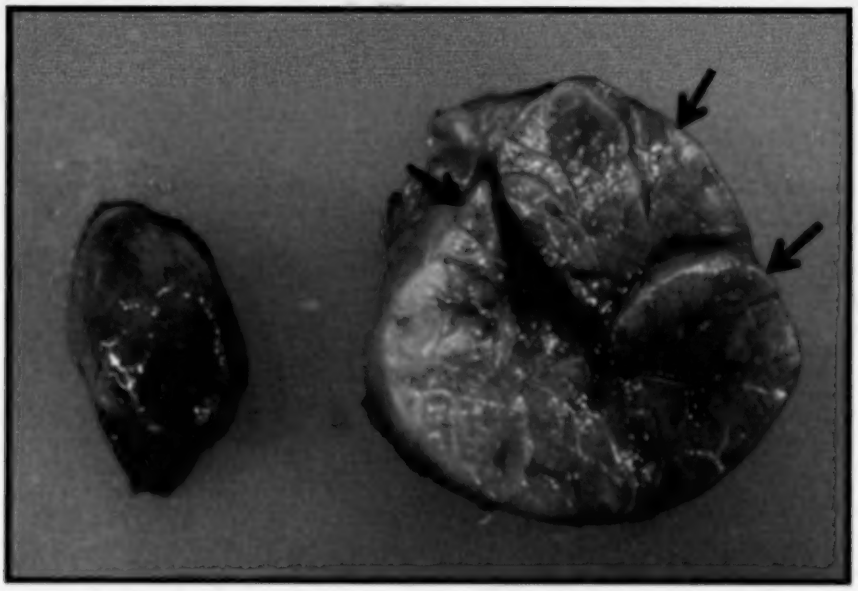

Figure 21. Cut surface of normal lymph node (left) and salivary gland (right) under the jaw of a dog. The lymph node has a uniform appearance, whereas the salivary gland has many distinct lobes (arrows).

Figure 22. Normal lymph nodes (arrows) associated with normal lungs (Lu) in a young grey seal. (Photo, H. Fenton)

Figure 23. Normal lymph nodes (arrows) associated with the stomach (St) and liver (Li) in a young grey seal. (Photo, H. Fenton)

Figure 24. Large, but normal, lymph node (arrow) among the loops of intestine in a young grey seal. Portions of the liver (Li) and a portion of the spleen (S) are visible. (Photo, H. Fenton)

Figure 25. One of several normal lymph nodes (arrow) in proximity to the kidneys (Ki) in a young grey seal. (Photo, H. Fenton)

Figure 26. Normal adrenal gland (lower part cut) just above the left kidney (Ki) of a young grey seal. (Photo, H. Fenton)

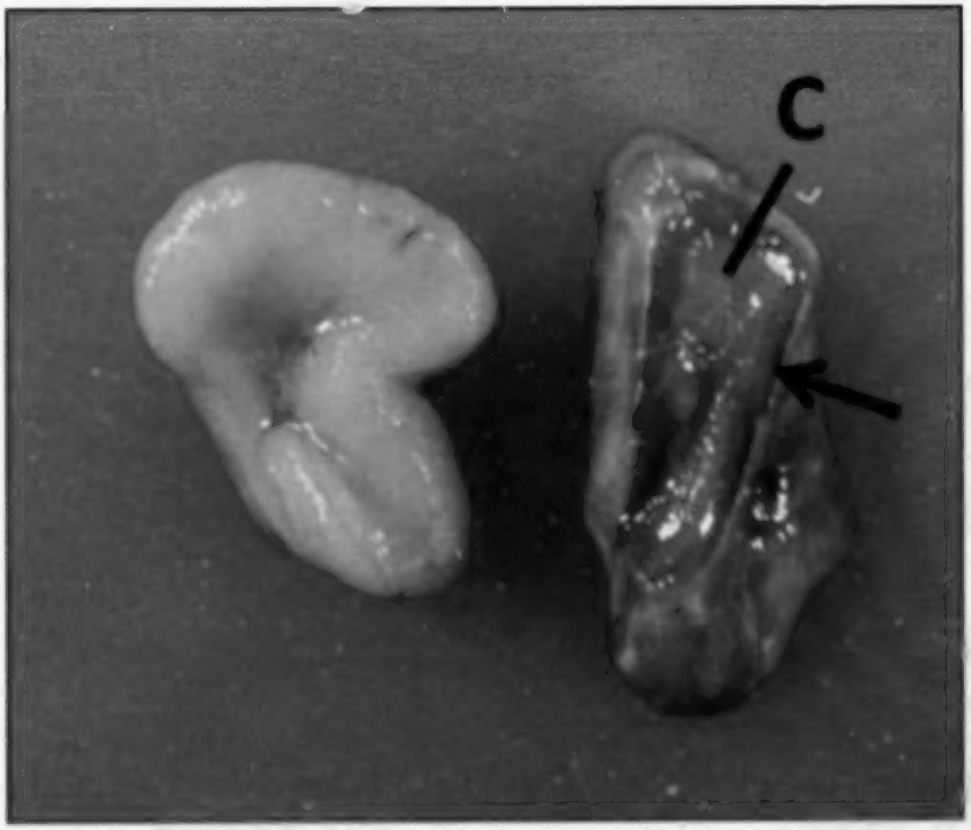

Figure 27. Cut surfaces of normal lymph node (left) and adrenal gland (right) from a cow. The lymph node has a uniform white color, whereas the adrenal gland has a distinct outer zone (arrow) and center (C).

Lungs

Normal lungs are pink, have a shiny surface, and feel soft and spongy (see Figures 13 and 22). Any large lump or firm, darkly coloured area within the lungs is abnormal (Figure 28; see also Figure 15).

The lungs of seals that have been clubbed or shot in the head often contain dark red blotches caused by bleeding. This may be caused by a sudden change in blood pressure and is a common finding in animals that have died from severe injury to the head. Figures 29A, B and C show different patterns of bleeding in the lungs of seals that died from severe injury to the head. As long as the lung tissue in the dark red areas is spongy, the seal is likely not diseased. However, severe bleeding in lungs that also feel heavy and firm because of build-up of fluid may indicate a serious disease process caused by a viral or bacterial infection (Figure 30). In this case, the seal is likely to have other areas showing evidence of disease, such as runny eyes. Its carcass and fat should be discarded.

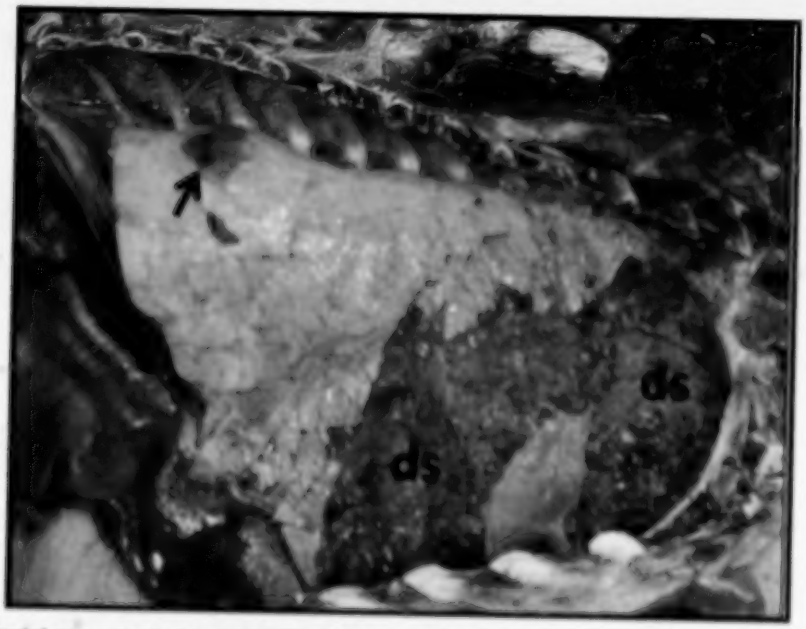

Figure 28. Bacterial pneumonia in a cow. Except for one lump (arrow), the back part of the lung has a normal colour and would have a spongy consistency. The front part (diseased, ds) has an abnormally dark color and would feel much firmer than normal. (Photo, A. López)

Figure 29A. Young grey seal killed by blows to the head from a club or a hakapik. The red blotches (arrows) correspond to bleeding within the lungs. The lungs are otherwise normal and would feel soft and spongy. Di, diaphragm. Li, liver. (Photo, H. Fenton)

Figure 29B. Harp seal killed by a rifle shot to the head. As in Figure 29A, this lung contains numerous small areas of bleeding (arrows) but is otherwise normal. (Photo, R. Russell)

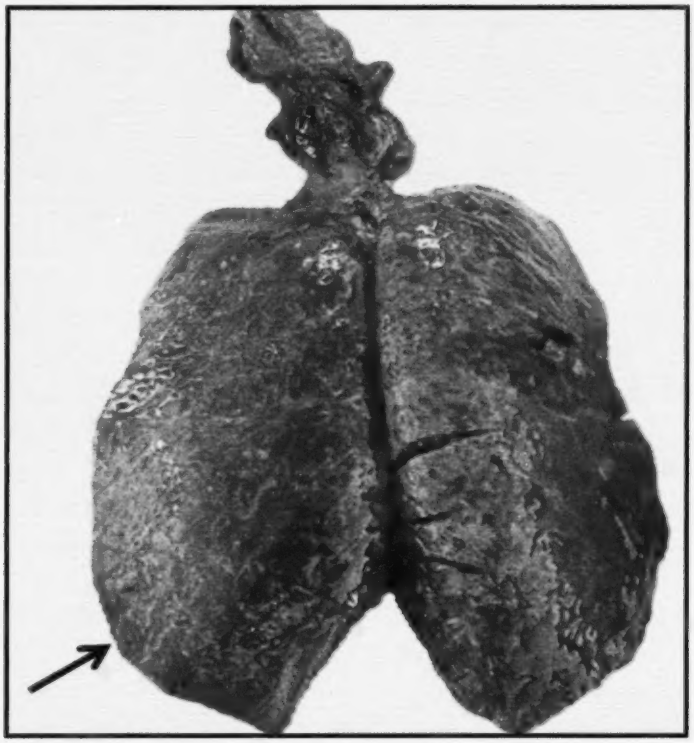

Figure 29C. Harp seal killed by a rifle shot to the head. The left lung (arrow) has very extensive bleeding but it otherwise normal. (Photo, R. Russell).

Figure 30. Harbour seal with a severe acute (see Glossary) viral infection of its lungs. Both lungs are filled with fluid and blood. (Photo, J. Geraci)

Heart

The heart muscle is normally dark brown, and numerous small blood vessels can be seen on its surface (Figure 31). A diseased heart muscle may have irregular areas that have a lighter colour than normal.

The right and left sides of the heart contain valves that direct the flow of blood within it. When the heart is removed from the rest of the organs, it can be cut along its base in such a way that the heart valves can be examined while the heart muscle itself is saved for further processing (Figures 31 and 32).

Normal heart valves are thin, white and shiny. Diseased heart valves may be discoloured and have a rough surface or carry lumpy, cauliflower-like growths (Figure 33). This is an indication of a severe bacterial disease. The heart valves move constantly, and parts of the lumpy growths can break off into the bloodstream, contaminating the entire carcass with bacteria. The carcass and fat of these seals should be discarded.

The main chamber on the right side of a seal's heart may contain parasitic worms resembling those that can be found in the lungs. A few worms are of no consequence for the seal, and the carcass and fat can be kept, but the heart should be discarded. However, large numbers of worms in the heart indicate an unhealthy animal that will likely have other abnormalities such as lung lesions (see Glossary) or a thin blubber (Figure 34). The carcass and fat of these seals should be discarded.

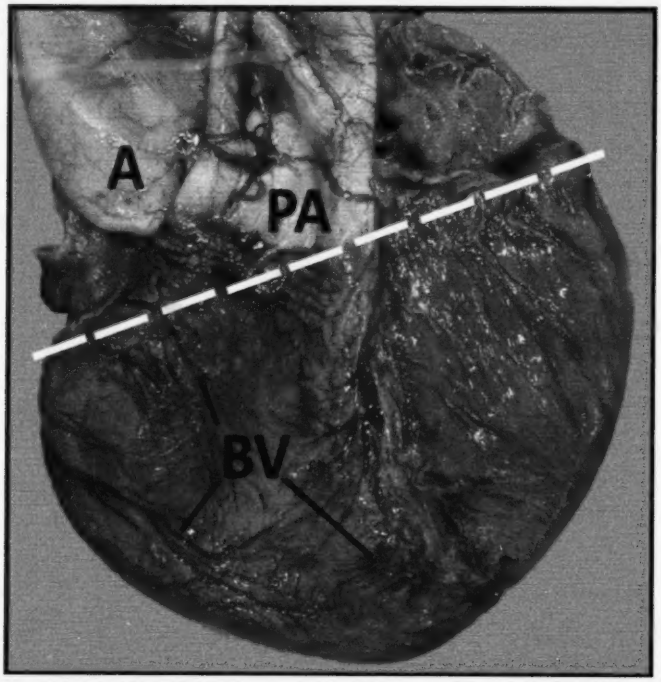

Figure 31. Normal heart of an adult hooded seal. The heart muscle has a dark brown color, and its surface contains numerous small blood vessels (BV). Two large blood vessels (aorta, A; pulmonary artery, PA) come out of its main chambers. The dotted line shows where the heart is normally cut by the sealers.

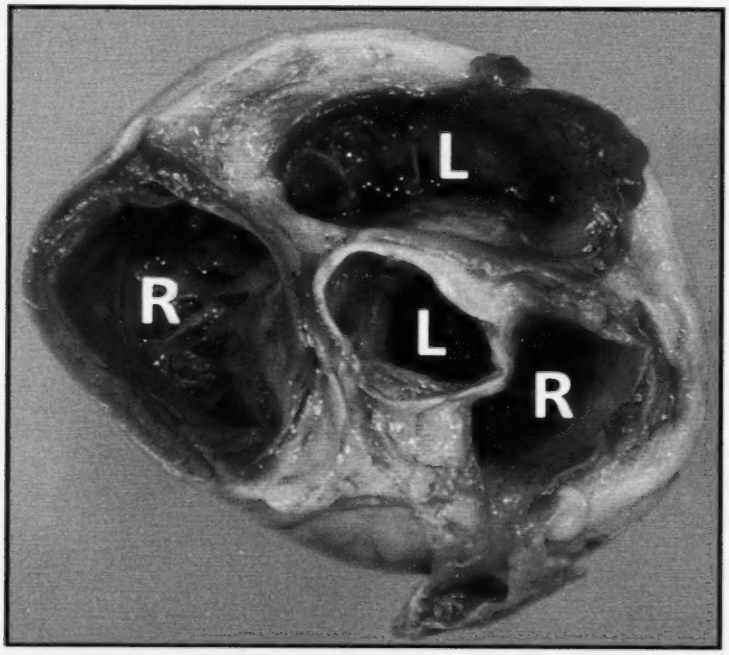

Figure 32. Dog heart cut along the line shown in Figure 31 and viewed from above. It shows the four openings to the chambers of the heart (two each on the right [R] and left [L] sides). With this cut, it is possible to inspect the valves associated with each opening for any abnormality. (Photo, A. López)

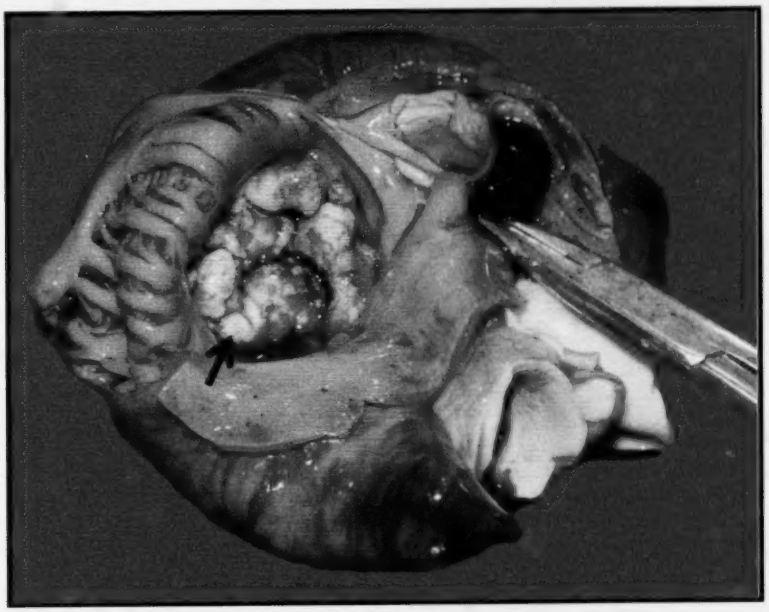

Figure 33. Heart of a cow viewed from above. Large cauliflower-like masses (arrow) are attached to the valves associated with one of the openings to the main chambers of the heart. This indicates a severe bacterial disease of these valves which could easily lead to contamination of the whole carcass with bacteria. (Photo, A. López)

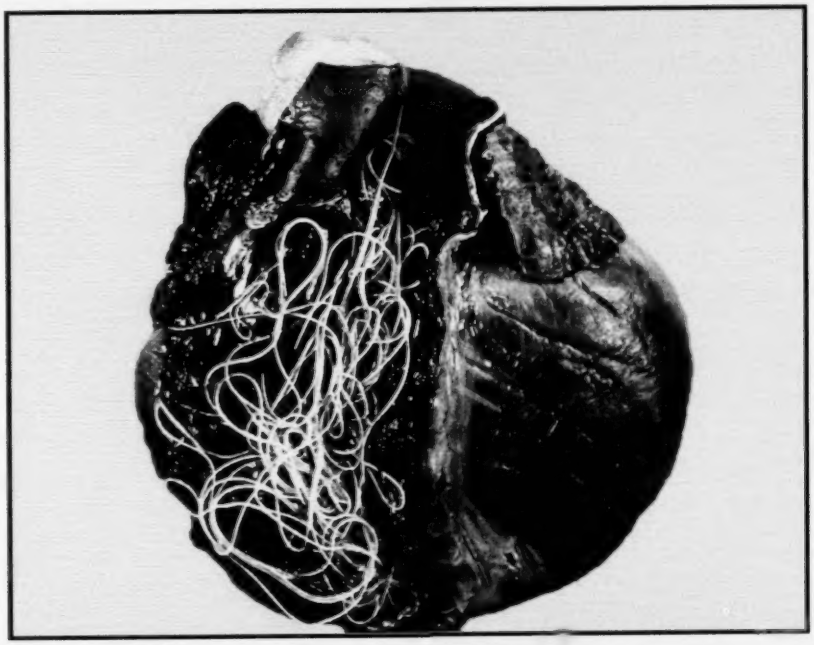

Figure 34. Heart of a harbour seal. The right main chamber has been opened to reveal large numbers of worms. These worms would have also been seen if the heart had been cut as shown in Figure 31. This seal was unhealthy. (Photo, J. Geraci)Liver

Liver

A normal liver is uniformly dark brown and has a smooth, shiny surface (see Figures 13, 14 and 23). Large numbers of small white spots visible on surface or on section of the organ indicate disease (Figure 35) which can result from a generalized infection by bacteria or viruses. The carcass and fat of these seals should be discarded.

Parasites that are in the liver or have moved through it can also cause white spots which tend to be bigger than those caused by bacteria or viruses. Seals with only a few of these spots are otherwise healthy, but the liver should be discarded. However, seals with large numbers of these spots are probably unhealthy and will likely have other abnormalities such as a thin blubber (Figure 36). The carcass and fat of these seals should be discarded.

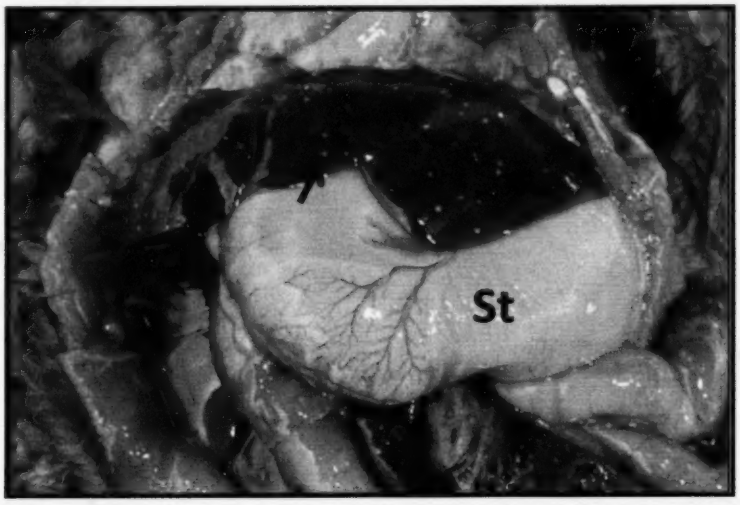

Figure 35. Large number of small white spots (arrows) in the liver of a muskrat, caused by an acute generalized bacterial infection. St, stomach.

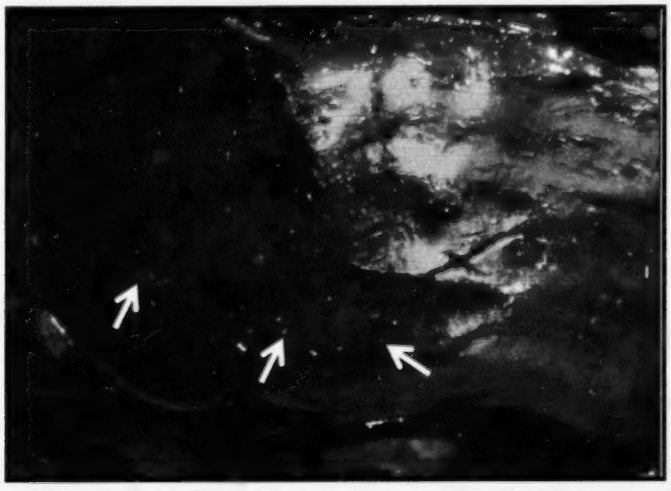

Figure 36. Large number of small white spots (arrows) in the liver of a young hooded seal, caused by the migration of parasites.

Digestive tract (stomach, intestine)

The surface of the stomach and of all loops of intestine should be shiny and smooth and of a pale colour (see Figures 23 and 24). Loops of intestine should not stick together or to the body wall.

Any obvious abnormality in the appearance of the digestive tract means that the large number of bacteria present within it may have contaminated the rest of the body. The carcass and fat of these seals should be discarded.

Kidneys

Normal seal kidneys have a brown, shiny surface (see Figure 25). They are actually made up of multiple miniature kidneys, like a densely packed bunch of grapes. Because of this, the cut surface shows multiple whitish areas, each surrounded by a brown layer, which is normal (Figure 37).

Kidneys with an irregular colour on the surface or which contain lumps or cloudy fluid when cut are likely infected, and the carcass and fat should be discarded.

Figure 37. Cut surface of the kidney of a normal young grey seal, showing numerous individual 'miniature kidneys' (arrows). (Photo, H. Fenton)

ZOONOTIC DISEASES ASSOCIATED WITH SEALS

A zoonotic disease is an infectious disease that can be transmitted to humans from animals. Since the 1940s, 60% of human infectious diseases that have emerged on the planet have been zoonotic. This and the fact that animals carrying infectious agents with a zoonotic potential do not necessarily show signs of disease themselves illustrate the importance of using

precautionary measures of sanitation when handling animals, whether they are domestic or wild.

Sanitary measures required by the CFIA's "Code of Practice for the Harvest, Transport, Processing, and Export of Seal Products Intended for Human Consumption" will help the harvester to protect himself from exposure to infectious agents. This section briefly describes some infectious agents found in seals that are recognized as having a zoonotic potential.

Sealers who experience any unusual health problems should mention to their family doctor that they have been in contact with potentially infected seals.

Some of the diseases described in this section (influenza, brucellosis, tuberculosis and trichinellosis) are reportable diseases (see Glossary), and the CFIA must be informed if they are suspected. Information about reportable diseases is available on the CFIA website.

If a reportable disease is suspected, the local CFIA District Veterinarian should be contacted. A list of CFIA offices can also be found on the CFIA website.

VIRUSES

Influenza

Influenza is a viral disease which is of significant concern for public health and the health of livestock, particularly poultry and swine. Wild birds, primarily waterfowl, but also shorebirds and gulls, are the main reservoir of influenza virus throughout the world. The virus is able to cause disease in other animals following a period of adaptation in its new host. It is well known that humans can contract influenza virus from animals.

Outbreaks of disease caused by influenza virus in seals have occurred at irregular intervals on the New England coast. The first outbreak was reported in 1980, and the latest in 2011. Most affected seals had signs of pneumonia, with breathing difficulty and discharge from the nose and eyes. Exposure to influenza virus, but not necessarily disease, has been shown to occur among seals in the Canadian Arctic.

The risk of infection of humans with influenza virus from seals is low. However, humans have developed eye infections after direct contact with sick seals

Calicivirus

Infection of sea lions and other marine animals by Calicivirus on the west coast of North America has been known for many decades. Disease caused by the virus is characterized by loss of appetite and the formation of blisters on the flippers and in the mouth; pregnant females may also abort. Between the early 1930s and the mid 1950s, this virus was implicated in the development of blisters on the feet of domestic pigs that had been fed animal products derived from seal carcasses. This resulted in great economic losses to the swine industry in the United States.

So far, there has been little evidence of the presence of this virus in marine animals in northwest Atlantic waters, but it has been identified in grey seals in British waters.

Humans appear to be susceptible to infection by marine Calicivirus and may develop a flu-like illness followed by the formation of blisters on hands and feet.

Seal pox

This is a skin disease of seals caused by a virus. It produces small lumps in the skin which eventually break open, may ooze some pus, and then heal, possibly leaving small scars without fur. A seal infected by pox virus can have many lumps or only a few which may not be noticed.

This virus appears to be widespread in seals in both the Pacific and Atlantic oceans.

Humans who come in contact with this virus may develop localized but painful sores on the fingers or hands where the virus has been able to penetrate the skin through small cuts. The sores start as blisters followed by a discharge of pus. They usually heal on their own, but this may take several weeks.

BACTERIA

Brucellosis

Brucellosis, caused by various species of the bacterium *Brucella*, has been present for a long time in domestic livestock worldwide and also in some species of wild ruminants such as bison and elk on this continent. It is recognized as a potentially serious disease in humans exposed to infected animals.

Infection by this bacterium has only recently been found in whales and seals worldwide, including seals in waters of the Atlantic and Pacific coasts of Canada. However, the disease itself has only been seen in whales, affecting several different organs and causing abortion, as it typically does in land mammals.

Human infection by *Brucella* bacteria from terrestrial mammals can be acquired through breaks in the skin, by exposure to infectious aerosols, or by ingestion of raw milk or undercooked infected tissues. There have been very few instances of people becoming sick from exposure to *Brucella* of marine origin. Interestingly, these people did not recall contact with marine mammals, but had eaten raw fish.

Tuberculosis

Tuberculosis is caused by various species of the bacterium *Mycobacterium* and can affect a wide variety of mammals and birds throughout the world. It is typically a chronic disease which results in the formation of many nodules or lumps of different sizes in several organs throughout the body, particularly the lungs, liver and lymph nodes. However, mildly infected animals may have small lesions only in some of the lymph nodes.

Tuberculosis has been seen occasionally in free-living wild seals of the South Pacific Ocean, particularly around Australia, but it has not yet been found in North Pacific or North Atlantic populations of wild seals.

Humans can acquire tuberculosis from animals by inhalation of infectious aerosols and, to a lesser extent, by ingestion of undercooked contaminated meat or by contact with infected organs or secretions from a diseased animal through breaks in the skin.

Salmonellosis

Different species of the bacterium *Salmonella* can be found in a wide variety of mammals and birds, especially in areas that may have been contaminated by sewage water or agricultural runoff. Salmonellosis can occur either as an intestinal or generalized disease. An animal can also carry the bacteria in its intestine without being sick.

Salmonella has been isolated from seals on the Pacific and Atlantic coasts of North America.

All species of *Salmonella* can cause disease in humans. Salmonellosis can be transmitted to humans through contact with an infected animal and through ingestion of undercooked contaminated food. It is usually limited to an intestinal disease which, however, can be severe.

Leptospirosis

Leptospirosis, caused by different species of the bacterium *Leptospira*, has a global distribution, infecting humans and a wide variety of domestic and wild mammals. It is the most widespread zoonotic disease worldwide and accounts for up to 30% of human cases of acute renal failure in developing countries. Affected animals can develop severe liver or kidney disease, and leptospirosis is also an important cause of abortion. Contamination of the environment is mainly through the urine of infected animals, but the bacteria can also be found in other body fluids, especially if an animal has just recently been infected. The bacteria need moisture to survive and are easily killed by dehydration.

Leptospirosis has been present for a long time in seal populations on the west coast of North America but has not yet been detected in seal populations on the east coast. It typically causes abortion in these animals, but it can also cause generalized disease in young seals.

On rare occasions, people handling diseased seals have developed leptospirosis. The usual portal of entry of the bacteria is through abrasions or cuts in the skin or through the eyes.

Seal finger

Seal finger may be the most common occupational infectious disease in people handing live seals or seal carcasses. This very painful disease is caused by infection of the skin and underlying tissues with Mycoplasma, a bacterium which can be found in the saliva and other body fluids of seals. The finger joints closest to where the bacteria penetrated the skin (either through small cuts or following a bite from a seal) become severely inflamed and swollen. The skin may become dark and discoloured, but there is usually no discharge. If left untreated, the infection can cause chronic arthritis of the affected joint and may also spread to the draining lymph nodes.

Cases of a disease comparable to seal finger in fishers are more likely to be caused by another bacterium known as Erysipelothrix. This infection is acquired from fish and is more appropriately named "fish-handlers' disease". In these cases there is swelling and pain of the affected finger, but the skin itself is mainly involved and becomes very red and inflamed, and there may be discharge.

It is very important to make a distinction between these two conditions because different antibiotics must be used for treatment.

PARASITES

Toxoplasmosis

Toxoplasmosis is caused by a microscopic parasite known as *Toxoplasma gondii*. It has a worldwide distribution and is one of the most widely distributed zoonotic diseases. Toxoplasma has a complex life cycle which typically involves its replication in the intestinal wall of domestic cats and the formation of microscopic cysts in various tissues of other animals such as rodents that ingest food contaminated by fecal material from cats. In animals, other than cats, that consume animals infected with *Toxoplasma*, the parasite bypasses the intestinal wall and goes directly to internal organs where it can form cysts and remain dormant or replicate and cause disease.

There is now good evidence that municipal runoff and storm wastewater have carried *Toxoplasma* from cat feces into the coastal marine environment, particularly on the west coast of North America. The parasite has caused disease and death in sea otters and, to a lesser extent, seals. Exposure to the parasite has also been demonstrated in belugas and seals in the

St. Lawrence Estuary and in seals in the Arctic, where it may have been introduced by wild birds.

Humans can acquire the parasite by consuming undercooked meat from infected animals or by inadvertent ingestion of soil or water contaminated by fecal material of infected cats. Infected humans often show no sign of disease, but when disease occurs it can affect any of the internal organs. The infection is of special concern to pregnant women as this parasite is notorious for infecting the fetus and causing abortion or disease in the newborn infant.

Trichinellosis

This disease is caused by a parasitic roundworm known as *Trichinella* which can be found in a wide variety of wild animals. Animals are infected by the worm when they eat immature stages of *Trichinella* present in muscles of other animals. These immature stages are too small to be seen with the naked eye.

In marine mammals in Canada, this parasite is found mainly in walruses and polar bears. It seems to be only rarely present in seals.

Most *Trichinella* infections in humans are caused by eating undercooked meat, and symptoms of the disease can be severe depending on the number of worms that are eaten with the infected meat. Chilling, freezing, or drying the meat does not kill the parasite, but well-cooked meat is safe to eat. Human infection by *Trichinella* is common enough that, in some northern Canadian communities, food safety programs have been established to test harvested meat for this parasite.

ACKNOWLEDGMENTS

The help of Paul Lawrence, Canadian Food Inspection Agency, Clarke's Beach, Newfoundland and Labrador, was critical in the production of this document. Comments from Christine Abraham, Don Bowen, Lean Measures, Ole Nielsen, and Stephen Raverty greatly improved the quality of its contents. We are also very grateful to the many people who contributed photos, an essential component of this document.

REFERENCES

Anonymous. 2009. Brucellosis in marine mammals. The Center for Food Security and Public Health, Iowa State University College of Veterinary Medicine. 7 p.

Anonymous. 2010. Seal tuberculosis in Australia. Fact Sheet. Australian Wildlife Health Network. 6 pages.

Anthony S.J., St. Leger, J.A., Pugliares, K., Ip, H. S., Chan, J. M., Carpenter, Z. W., Navarrete-Macias, I., Sanchez-Leon, M., Saliki, J. T., Pedersen, J., Karesh, W., Daszak, P., Rabadan, R., Rowles, T. and Lipkin, W. I.. 2012. Emergence of Fatal Avian Influenza in New England Harbor Seals. mBio 3(4):doi:10.1128/mBio.00166-12.

Cowan, D.F., House, C., and House, J.A. 2001. Public health. In: CRC Handbook of Marine Mammal Medicine. Dierauf, L.A. and Gulland, F.M.D., Editors. CRC Press, pp. 767-778.

Forbes, L.B. 2000. The occurrence and ecology of *Trichinella* in marine mammals. Veterinary Parasitology 93:321-334.

Forbes L.B., Nielsen, O., Measures, L and Ewalt. D.R. 2000. Brucellosis in ringed seals and harp seals from Canada. J. Wildl. Dis. 36:595-598.

Higgins R. 2000. Bacteria and fungi of marine mammals: A review. Can. Vet. J. 41:105-116.

Hunt, T.D., Ziccardi, M.H., Gulland, F.M.D., Yochem, P.K., Hird, D.W., Rowles, T., Mazet, J.A. K. 2008.Health risks for marine mammal workers. Dis. Aquat. Organ. 81:81-92.

Kennedy-Stoskopf, S. 2001. Viral diseases. *In*: CRC Handbook of Marine Mammal Medicine. Edited by Dierauf, Leslie A., Gulland, and Frances M.D. CRC Press pp. 285-307.

Measures, L.N., Dubey, J.P. Labelle, P., and Martineau, D. 2004. Seroprevalence of *Toxoplasma gondii* in Canadian pinnipeds. J. Wildl. Dis. 40:294-300.

Messier, V., Lévesque, B., Proulx, J-F., Rochette, L., Libman, M. D., Ward, B.J., Serhir, B., Couillard, M., Ogden, N. H., Dewailly, É., Hubert, B., Déry, S., Barthe, C. Murphy, D., Dixon, B.. 2008. Seroprevalence of *Toxoplasma gondii* among Nunavik Inuit (Canada). Zoonoses Public Health 56:188–197.

Mikaelian, I., Boisclair, J. Dubey, J.P., Kennedy, S., and Martineau, D. 2000. Toxoplasmosis in beluga whales from the St. Lawrence estuary: two case reports and a serological survey. J. Comp. Path. 122:73-76.

Nielsen, O., Clavijo, A., and Boughen, J.A. 2001. Serologic evidence of influenza A infection in marine mammals of Arctic Canada. J. Wildl. Dis. 37:820-825.

Nielsen, O., Stewart, R.E.A., Nielsen, K., Measures, L., and Duignan, P. 2001. Serologic survey of *Brucella* spp. antibodies in some marine mammals of North America. J. Wildl. Dis. 37:89-100.

Stack, M.J., Simpson, V.R., and Scott, A.C. 1993. Mixed poxvirus and calicivirus infections of grey seals (*Halichoerus grypus*) in Cornwall. Vet. Rec. 132:163-165.

Tryland, M., Nesbakken, T., Robertson, L., Grahek-Ogden, D., and Lunestad, B.T. 2013. Human pathogens in marine mammal meat – a northern perspective. Zoonoses Public Health doi: 10.1111/zph.12080.

Vlasman, K.L. and Campbell, G.D. 2003. Field Guide. Diseases and Parasites of Marine Mammals of the Eastern Arctic. Canadian Cooperative Wildlife Health Centre. 109 p.

Waltzek, T.B., Cortés-Hinojosa, G., Wellehan, J.F.X., and Gray, G.C. 2012. Marine mammal zoonoses: a review of disease manifestations. Zoonoses Public Health 59:521-535.

GLOSSARY

Abscess – a localized collection of pus surrounded by a capsule of scar tissue, most often caused by a bacterial infection.

Acute disease – a disease that develops over the course of a few to several days.

Chronic disease - a disease that persists for weeks or even months.

Emaciation – severe weight loss associated with exhaustion of fat reserves and loss of muscle mass and caused by malnutrition, chronic disease, or a combination of both.

Immune system – the body's defence system against microbes, parasites, and foreign material (e.g., splinters, pollen); it is made up of various organs located throughout the body, such as spleen, lymph nodes, and bone marrow.

Inflammatory material – material (fluid and cells) produced by inflammation, which is a protective reaction of tissue to irritation, injury, or infection, and is characterized by pain, redness, swelling, and possibly loss of function.

Lesion – any structural change in a tissue or organ resulting from injury or disease.

Microbes – microscopic living organisms, e.g., viruses, bacteria, protozoa, yeasts, fungi.

Organ – a specific part of the body with a specialized function, e.g., lung, liver, brain.

Reportable disease – a disease which has significant importance to human or animal health, or to the Canadian economy. Animal owners, veterinarians and laboratories are required to immediately report the presence of an animal that is contaminated or suspected of being contaminated with infectious agents responsible for one of these diseases to a CFIA veterinarian.

NOTE: The definition of a reportable disease was developed with domestic animals in mind. Although seals are not owned, and there may not be a veterinarian present during harvesting, a CFIA veterinarian should still be informed if signs of a reportable disease are noted.

Tissue – a structural part of the body, e.g., bone, muscle, skin.

Zoonotic disease – A disease (also known as **zoonosis**) that can be transmitted from animals to humans.